

THE

Malayan Agricultural Journal.

Vol. X.

JUNE, 1922.

No. 6.

EDITORIAL NOTES.

THE Netherlands Indies Review published by the British Chamber of Commerce for the Netherlands East Indies is an interesting monthly paper. In the Trade Review for 1921 which appears in their issue for June, 1922 the following note on Kapok appears :—

KAPOK :

This might be mentioned as perhaps the only article that could resist the great fall in prices, to which almost all products of the Dutch Indies were subject last year. Together with high prices we may speak of a satisfactory turnover, especially in this country, although in the second half of the year Germany completely fell away as a purchaser.

FIBRE BALING PRESS :

With reference to the editorial note in this Journal Vol. X, No. 3, March 1922, giving the capacity of the fibre baling press, it has since been found possible to prepare bales measuring 3 ft. 7 ins. $\times$ 2 ft. 7 ins. $\times$ 2 ft. (*i.e.*, 18.5 cubic feet) containing 420 lbs. of fibre, with a compression on the ram of 80 kilogrammes per sq. cm. This represents 1140 lbs. of fibre or almost exactly $\frac{1}{2}$ ton per 50 cubic feet, and represents a considerable saving in shipping space over the figures quoted previously.

PALM OIL AND INTERNAL COMBUSTION ENGINES :

With reference to the information contained in the Agricultural Bulletin Vol. IX, No. 2, 1921, on the use of palm oil as a fuel for internal combustion engines the following information received from Messrs. Roby & Co., Ltd., of Lincoln, England in respect of engines manufactured by this firm may be of interest.

The features claimed for these engines are :—

- (a) low fuel consumption
- (b) water injection is not used to obtain full load
- (c) sensitive governor regulating the supply of oil according to load
- (d) large cylinders per horse power
- (e) margin of power for overloading.

It is stated that any grade of oil can be used in these engines the consumption of crude oil being about 0.55 lbs. ($\frac{1}{2}$ pint) per B.H.P., per hour.

The fuel consumption, using palm oil, is stated to be 0.6 to 0.65 lbs. per B.H.P., per hour. No alterations are necessary for running on this oil, while no water injection is required.

It might perhaps be advisable to mention that the above information in respect of a particular type of engine is given on account of the fact that these engines have been tested and advertised as suitable for palm oil as a fuel.

Further details in respect of the cost of these engines of different horse power can be obtained on application to the Secretary for Agriculture. (Quote D.A. 1191/22).

SELECTED WET PADI SEED:

The Department of Agriculture has still a limited stock of seed of selected pure strains of several varieties for sale at .14 cts. per gantang F.O.R. Parit Buntar. These strains vary in maturation period from five and a half to eight months. Applicants should apply direct to the Economic Botanist, Department of Agriculture, Kuala Lumpur stating their requirements and the district in which it is desired to sow the seed.

PLANTING MATERIAL

On page 171 of this journal will be found a Price List of Planting Material, both of Economic and Non-economic plants, obtainable from this Department.

Seed of the following crops can be obtained from the Manager, Fordson Estate, Bagan Datoh.

Jute (2 varieties), Roselle (Green), Mauritius Bean, Centrosema, Indian Tobacco and Kapok. Kapok seedlings are also obtainable from the same estate.

OBITUARY.

The late Lawrence Lewton Brain, B.A., F.L.S., Technical Adviser, Department of Agriculture, F.M.S. and S.S.

We have to record with deep regret the death of Mr. L. Lewton Brain, B.A., F.L.S. formerly Director of Agriculture, F.M.S. and S.S. and more recently Technical Adviser, Department of Agriculture, F.M.S. and S.S. which occurred at the European Hospital, Kuala Lumpur on the 24th June at the early age of 43.

Mr. Lewton Brain who had returned from long leave as recently as April, died of heart failure following an attack of malignant malaria.

Mr. Lewton Brain was educated at St. John's College, Cambridge, and was appointed subsequently Junior Demonstrator of Botany in the University. In 1902 he was appointed Mycologist and Lecturer in Agriculture to the Imperial Department of Agriculture for the West Indies.

He resigned his appointment in 1905 on being offered the appointment of Assistant Director in the Division of Pathology and Physiology at the Experiment Station of the Hawaiian Sugar Planters' Association.

In 1910 he accepted the post of Director of Agriculture, F.M.S. and arrived in November of that year.

In 1919 he was appointed Director of Agriculture, F.M.S. and S.S. when the activities of the Department were extended to include the Straits Settlements as well as the Federated Malay States.

During his tenure of office as Director, the activities of the Department were considerably extended and the staff increased and organised to meet the great developments in the Agricultural Industries of Malaya, particularly in respect of rubber cultivation. Had it not been for the war, there is no doubt that the development of the Department and the results of its work would have been far greater, since many of the appointments sanctioned in 1914 were not filled until 1921 and 1922, and almost every Division was single-handed. At the time of his death the Department was one of the best equipped Departments of Agriculture in the Colonies and Protectorates of the Empire.

On the abolition of the appointment of Director in 1922 Mr. Lewton Brain was appointed Technical Adviser, which post he held at the time of his death.

During his tenure of office he earned the respect of the European, Malay and other Asiatic officers of the Department. The officers of the Department offer their deepest sympathies to his wife and children in their bereavement.

THE PRESERVATION AND PACKING OF LATEX FOR SHIPMENT.

By B. J. EATON.

THE most satisfactory preservative for latex, as far as is known at present, is Ammonia.

Experiments are being carried out with other substances as a substitute for ammonia, since this chemical is somewhat dangerous to handle and is expensive, especially at the present local price.

There is a number of substances which can be used in lieu of ammonia; and which are more satisfactory and economical, but until further information is available as to the purposes for which consignments of latex are required and the subsequent treatment to which the latex is subjected it is not advisable to add these, except in the case of small samples sent as experimental shipments.

Thus sodium hydroxide and carbonate can be used, while potassium cyanide, in very small quantities, is an excellent "preservative" but probably too dangerous to use. Preservatives such as boric acid are practically useless. Sodium phenate will probably prove an excellent chemical, provided the free alkali is subsequently neutralised. Small quantities of the soluble fluorides (sodium, potassium and ammonium fluorides) may also prove suitable and economical.

At the present time however, the use of ammonia is advocated and the following recommendations are made:—

Ammonia may be used

- (a) in the form of the strong solution known in commerce as Liquor Ammon Fortis.
- (b) in the form of gas obtained from cylinders of the compressed gas.
- (c) generated as a gas from salts of ammonia, e.g. ammonium sulphate or ammonia chloride, in an apparatus on the estate.

LIQUOR AMMON FORTIS.

The strongest solution of ammonia on the market is Liquor Ammon Fortis which has a density of 0.880 and contains about 35 per cent. by weight of NH_3 (Ammonia) gas.

Liquor Ammon Fortis (B.P.) has a density of 0.888 and contains 32.5 per cent. of Ammonia gas by weight.

The solution however is saturated at a lower temperature in a cold climate, so that when it reaches the tropics in sealed drums or bottles, the solution is supersaturated and consequently under pressure.

When drums or vessels containing the solution are opened at the average shade temperature in this country, a large portion or even the whole of the contents of the vessel may spout up in the form of a strong fountain and if the operator opening the vessel is standing or leaning over the opening, he may receive the charge in his face, and may be rendered blind or otherwise hurt.

When opening such drums therefore, it is advisable to stand the drum in a tank of cold water, immersing the drum to about three quarters of its height. The stopper should be carefully unscrewed and the operator should do this by standing or sitting at arm's length from the drum.

Method of Application:—The solution of ammonia should be added to the extent of 2 per cent. on the volume of latex or say $3\frac{1}{4}$ fluid ozs. or 8 ozs. by weight per gallon of latex. (Note:—The writer has examined a sample of ammonia recently, which contained only 20 per cent. instead of 32.5 per cent. of ammonia (NH_3). Even after making allowance for the loss of gas at the higher tropical temperature, the strong solution should contain about 28 per cent. of ammonia gas).

AMMONIA GAS IN CYLINDERS.

The writer has found that the compressed gas in steel cylinders, which is used in this country for refrigerating purposes, can be substituted satisfactorily for the strong solution. The use of the strong solution-Liquor Ammon Fortis-or the compressed gas is principally a matter of relative cost. Approximately one-third of the weight of ammonia gas is equivalent to the strong solution of Liquor Ammon Fortis.

Thus, if Liquor Ammon Fortis can be purchased at \$5 per gallon, (9 lbs. approximately) i.e. at \$1.65 per 3 lbs., Ammonia gas in cylinders must be less than \$1.65 per lb. in order to be more economical for use.

The gas may be used either by making a saturated solution by passing it into water or by passing the gas direct into latex.

Since the addition of less than 1 per cent of the gas is required in latex, there would be no loss of gas and very little heat developed by passing the gas direct into the latex in large tanks. The writer favours this method.

If the gas is passed from the cylinders into water in order to make a saturated solution, which can be added subsequently to the latex, the most satisfactory method is to attach a series of branch pipes to the main exit pipe from the cylinder and to lead these branch pipes nearly to the bottom of a large vessel or series of vessels, e.g. 4 gallon kerosene tins, containing water. An alternative method is to connect the main

pipe from the cylinder to a T piece of piping of suitable length, the head of the T piece being perforated to allow the gas to escape through the perforations.

The absorption vessels containing water should be placed preferably in a large tank through which cold water is run continuously, so that the heat developed during the absorption of the gas by water is not too great. This method has worked quite satisfactorily and a saturated solution containing about 17 per cent of ammonia gas has been prepared in this way on an estate.

Provided there is no leakage in the connecting pipes and when large quantities of latex are treated direct with the gas from the cylinders, the amount absorbed by the latex can be determined with sufficient accuracy by the loss of weight of the cylinder of gas : 1 lb Ammonia gas is sufficient for 16 gallons of latex.

PREPARATION OF AMMONIA GAS FROM SALTS OF AMMONIA (AMMONIUM SULPHATE OR CHLORIDE) ON THE ESTATE.

Although this method has not yet been adopted in practice, the writer considers that the most economical method would probably be to import ammonium sulphate or chloride, which are not dangerous chemicals from a shipping or any other point of view, and to prepare ammonia gas direct on the estates in a small apparatus which can be designed fairly easily.

The only other chemical required is quick or slaked lime which is readily obtainable.

By heating these two compounds together, i.e. slaked lime with ammonium sulphate or chloride, ammonia gas is generated and with a safety gauge between the generator vessel containing the latex, to prevent any back suction, the gas can be passed direct into the latex.

If there is no leakage in the apparatus, the amount of ammonium salt and lime (the latter in excess) required for any particular volume of latex can be easily determined.

LATEX.

In order to save freight on water, the latex, which is to be preserved for shipment, should be collected "dry" and should contain at least 3 lbs of dry rubber per gallon (This should be feasible except on a wet day). The latex should be strained carefully and the ammonia added as soon as possible after the latex reaches the factory, in order to inhibit preliminary fermentation and formation of acid in the latex.

PACKING FOR SHIPMENT.

Latex preserved by one of the methods described above can be shipped

- (a) In kerosene tins carefully sealed by soldering, packing 2 a wooden box or crate so that they fit tightly.

(b) In steel drums.

(c) In tanks or tank steamers.

The vessels (tins or drums) containing the latex should be cleaned thoroughly before being used.

If the drums or tins contain traces of oil, this can be removed by blowing steam into them.

Remarks:—Recently, Liquor Ammon Fortis (the most concentrated solution of ammonia obtainable has been sold locally at \$5/- per gallon, but it is understood that it can be obtained and sold locally at about half this price.

Compressed ammonia gas contained in cylinders cost recently \$1.70 per lb., excluding the price for the cylinder, which is returnable.

NOTE:—The writer has been informed recently that a London quotation has been received offering Liquor Ammon Fortis (0.880) C.I.F. Port Swettenham at £57. 5s. per ton which is equivalent to \$1.93 per gallon or considerably less than half the present local price.

A CONSIDERATION OF RECENT WORK ON THE BROWN BAST PROBLEM.

BY A. SHARPLES.

THE recent depression in the rubber industry has produced results far-reaching in many directions and has considerably affected the relation of the industry to scientific research. During the period when each pound of rubber yielded a large profit Brown Bast was one of the most important disease problems. Under a profitable regime, estates were prepared to try for maximum yields with, in the majority of cases, a resultant large increase in number of Brown Bast cases. Under such circumstances, this problem was urgent, but with decreased demand and a call for restriction Brown Bast has not been so much in evidence.

A Brown Bast Investigation Committee was formed in 1918 in Malaya. The following gentlemen served on the Committee at its inception:—

Mr. F. W. South	- - -	Chief Agricultural Inspector, F.M.S. (<i>Chairman.</i>)
„ W. N. C. Belgrave	- - -	Acting Mycologist, F.M.S.
„ G. E. Coombs	- - -	Government Botanist, (<i>Secretary.</i>)
„ A. G. G. Ellis	- - -	Assistant Agricultural Inspector, Perak, F.M.S.
„ W. M. Miller	- - -	Mycologist, Carey Island Rubber Estates
„ F. de la Mare Norris	- - -	Assistant Agricultural Inspector, Negri Sembilan, F.M.S.
„ H. C. Pinching	- - -	Mycologist, R. G. A., Ipoh.
„ G. E. Perry	- - -	Mycologist, Societie Financiere, Kuala Lumpur.
„ R. M. Richards	- - -	Mycologist, M. P. A., Caledonia Estate, Province Wellesley.
„ H. Sutcliffe	- - -	Mycologist, R.G.A., Petaling.
„ H. H. Stirrup	- - -	Acting Assistant Agricultural Ins- pector, Johore.

Other gentlemen who served on the committee were Mr. B. J. Eaton, Agricultural Chemist, F.M.S., Mr. A. L. Sanderson, Mycologist, R. G. A., Petaling, and the writer, who on arrival in Malaya in 1920 was co-opted a member of the committee.

Many changes took place between 1918-20 owing to officers taking leave. Mr. R. M. Richards was Chairman for a part of the time after Mr. South had gone on leave. In 1920 only two meetings were held and as the attendance was poor and no concerted efforts were being made, the committee practically disbanded by default.

The meetings were held in the offices of the Department of Agriculture, Kuala Lumpur, F.M.S. and the minutes recorded and kept there. The last meeting took place in February 1920, when the chairman, Mr. R. M. Richards promised to write up and publish the minutes, to indicate the work attempted and done. Owing to ill-health Mr. Richards went suddenly to England and as no information is forthcoming as to his attempt to collect the information contained in the minutes of the committee, the writer, with the permission of the Acting Director of Agriculture, Mr. B. J. Eaton decided to give a resumé of the work done in Malaya. This is of more importance in view of several articles recently published by Rands (1), Sanderson and Sutcliffe (2), and Farmer and Horne (3 & 4.)

The work of Rands was contemporary with that of the Brown Bast Investigation Committee (B.B.I.C.) and in many cases similar lines were followed. It will be interesting to indicate the issue of results in Java and in Malaya.

EXPERIMENTS TO ISOLATE A CAUSAL ORGANISM.

Rands (loc cit) details numerous attempts to isolate a causal organism but concluded that no organism was secured with sufficient consistency to warrant suspicion as a possible cause. The experiments carried out by the various members of the B. B. I. C. of Malaya, to be detailed below, support Rand's conclusions.

Previous to the formation of the B. B. I. C. in Malaya, Belgrave (5) had suggested a *Spongospora* sp. (or lowly Alga) which he had observed in diseased tissues, as a possible cause. Further work led him to abandon this view. On the formation of the B. B. I. C. various members were delegated to attempt to isolate a causal organism. Various media were used for the isolations and a summary of the organisms isolated is given:—

- (1) Large Bacterium.
- (2) *Pestalozzia* Sp.
- (3) *Bacillus* giving white, glistening colonies on agar—this organism was often obtained from burred tissue.

-
- (1) Rands. R. D.:—Brown Bast Disease of Plantation Rubber. Its Cause and prevention; *Archief Voor de Rubber Culture in Nederlandsch-Indie*. 5c. Jaargang. No. 5 Mei, 1921.
 - (2) Sanderson A. R. & Sutcliffe H: Brown Bast. An investigation into its causes and method of treatment. 7/6 net. Rubber Growers Association 38 Eastcheap London E. C. 3.
 - (3) Farmer J. B. & Horne A. S: Phloem Necrosis. Brown Bast Disease in *Hevea brasiliensis*; *Annals of Botany* Vol. XXXV, No. CXXXIX July, 1921.
 - (4) Farmer J. B. & Horne A.S.: On Brown Bast and its immediate cause; *India Rubber Journal* Vol. LXI No. 25 June 18, 1921.
 - (5) Belgrave W. N. C:—A preliminary Note on Brown Bast, No. 1 Vol. VI. *Agricultural Bulletin* F. M. S. October. 1917.

(4) A Coccus form or possibly a Streptococcus, accompanied by a small number of larger bodies, possibly spores.

(5) A large hyaline Yeast-like organism.

(6) A large spore-like Bacterium, different from (5),

(7) An unidentified fungus peculiar in that the hyphae in agar soon disintegrate, leaving only a few crystals.

(8) *Hormodendron Sp.*

(9) From scaled bark :—

(a) A Basidiomycetous fungus.

(b) *Mucor Sp.*

(c) A fungus with pycno-and stylospores.

(d) A green Bacillus.

(10) Isolations made from longest infected spots gave *Trichoderma viride* in many cases.

This long list undoubtedly supports Rands conclusion stated above.

EXPERIMENTAL INOCULATIONS AND ATTEMPTS TO TRANSFER BROWN BAST FROM DISEASED TO HEALTHY TREES.

The proof of an organism causing a disease depends largely upon the results obtained by inoculating healthy trees with pure cultures of the suspected organism. Rands (loc. cit.) details numerous and varied attempts to inoculate healthy trees artificially and endeavoured to set up Brown Bast symptoms by transference of diseased tissue to healthy trees. Similar experiments were tried by the B. B. I. C. and the results obtained in the two series were in entire agreement. The B. B. I. C. worked with a larger variety of organisms in pure culture ; in some cases promising results were obtained.

The organisms, listed above, were isolated from bark, both lightly and badly affected, and from soil surrounding the roots of diseased trees. All inoculations were negative in outcome. With Nos. (2) & (4) discolorations were obtained, but these did not progress. At first, encouraging results were on hand with No. (10). (*Trichoderma viride*) but again, final results were negative.

Rands performed inoculation experiments with Bacteria isolated in Sumatra by Keuchenius. This author claimed (1) that his inoculation experiments argued against a physiological cause. Rand's inoculation experiments with the cultures obtained from Sumatra gave entirely negative results, even after repetition to allow for the objections raised by Keuchenius regarding the first series. The B. B. I. C. wrote for cultures to be sent over from Sumatra but it was not a convenient time for despatch. However, the reply from Mr. Carl De La Rue contained a further expression of faith in a Bacterial origin of the disease.

The inoculation experiments with pure cultures were unsuccessful both in the case of Rands and of the B. B. I. C. This point being reached it became necessary to attempt to transfer the disease from affected to healthy trees by other methods. The attempts made in Malaya practically parallel those made by Rands in Java. A short summary of the later experiments will be useful to compare with the Malayan results.

- (a) Diseased bark ground up and washed in sterile water. 5 c.c portions were injected into the bark of 22 seedlings. 17 controls were injected with sterile water. Results negative. Similar results were obtained in Malaya.
- (b) Material from a case of Brown Bast a few weeks old macerated in water and plastered into wounds on trees 10 years old. 78 inoculations were made and 70 controls kept. Discolorations were noticeable but of a purely local nature and as no spread was visible after a year, this could not be considered Brown Bast. This sound conclusion has some bearing on the experiments carried out by Keuchenius. The results obtained in Malaya by similar experiments support Rands conclusion.
- (c) Previously untapped trees were used in this experiment and inoculations were made in wounds as follows:—
 - (1) Diseased bark macerated in sterile water and 132 inoculations made in 28 trees.
 - (2) Diseased bark macerated and sterilised in the autoclave for thirty minutes at 3 kg. pressure. 100 inoculations made in 25 trees.

(1) Keuchenius P. H.—Onderzoekingen over Bruine Bastziekte. Archief Voor de Rubber Culture in Norderlandsch-Indie, Jaargang 4 Feb. 1920 No. 1.

- (3) Healthy bark unsterilised, macerated. 100 inoculations in 25 trees.
- (4) Healthy bark macerated and sterilised. 100 inoculations made in 25 trees.
- (5) Sterile pads of absorbent cotton were soaked in sterile distilled water. 68 inoculations made in 17 trees.

Similar results were obtained as in a previous experiment (Supra) Discolorations were observed around the places of inoculation; the wounds to which rain water penetrated showed most reaction but no real Brown Bast was obtained. The same results were obtained in Malaya with similar experiments.

- (d) Grafting and transplanting diseased bark in healthy trees.

An attempt to transfer the disease by transplanting and grafting diseased bark in healthy trees was made. Rands reports that practically all the grafts failed to connect up completely but there was no spread of the disease.

In Malaya, successful grafts were obtained but again there was no spread of the disease.

- (e) Experiments (b) & (d) were repeated on previously untapped trees. These trees were previously subjected to heavy tapping in an attempt to weaken them so that any weak parasite might have a better chance of establishing itself. Results were again negative.

There is no record of a similar experiment in Malaya. The B. B. I. C. instituted a long series of experiments to test the action of various solutions when injected into the bark of healthy trees. The first series was made by inserting tubes, containing the various solutions, in holes made in the bark with a cork borer of equal diameter to the tube, which was fixed in place with plasticene.

The solutions tried were:—

- | | |
|----------------------------|--------------|
| (1) Cane Sugar..... | 5% solution. |
| (2) Glucose..... | 5% „ |
| (3) Chloroform Water..... | |
| (4) Sodium Carbonate..... | 2% „ |
| (5) „ Chloride..... | 2% „ |
| (6) Acetic Acid..... | 10% „ |
| (7) Citric Acid..... | 10% „ |
| (8) Hydrochloric Acid..... | 0.5% „ |
| (9) Phosphoric Acid..... | 5% „ |

- | | | |
|------|------------------------|-----------------|
| (10) | Oxalic Acid..... | 10% solution. |
| (11) | Lactic Acid..... | 10% ,, |
| (12) | Tartaric Acid..... | 10% ,, |
| (13) | Nitric Acid..... | 0.5% ,, |
| (14) | Sodium Hydroxide..... | N/20 ,, |
| (15) | Ammonia Water..... | 0.5% ,, |
| (16) | Mercuric Chloride..... | 1 in 1000 ,, |

No definite re-action was noted with any of these solutions. Further experiments were made using small plaster of paris casts impregnated with Chloroform, Ether, Ammonia, Prussic Acid, and Hydrogen Peroxide, which were placed in close contact with wounded bark. No re-action was noted with these substances except in the case of Prussic Acid, when a marked poisoning effect was noticeable.

The total failure of the numerous attempts to transmit the disease by artificial methods led to the suggestion, emanating from Belgrave (vide Rands), of a "non-infectious disease of physiological origin." This suggestion stimulated research along different lines and the general result can be stated that all experiments tend to support this view.

Keuchenius (loc. cit.) has steadily supported the opposite view of a possible Bacterial origin of Brown Bast. The writer has referred above to the inoculation experiments published by Keuchenius and on the data presented he states that "attention to the infection theory and more experimental Bacteriological work on Brown Bast is necessary and the fact that bacteria can be isolated from Brown Bast is very strongly against the physiological theory but does not prove that those Bacteria are the cause of Brown Bast."

Keuchenius bases these statements on certain inoculation results. These results show that 40 inoculations with Bacteria were made and 40 controls were kept. In both series discolorations progressing from the place of inoculation were obtained. The length of the discoloration in both series was totalled; The total for the inoculated series was 177.5 cm. and for the controls 59.5 cm. The difference between those numbers is considered sufficient justification for the above statements.

A different interpretation, and a more acceptable one, can be placed on these results when subjected to analysis. This shows that 20 of the bacterial inoculations showed increase in length of discoloration as compared with the controls, while 16 of the bacterial inoculations show no difference and the remaining 4 show that the controls have an increase in length of discoloration over the bacterial inoculations. Thus there are 20 positive and 20 negative results. The writer would suggest as the only logical conclusion that such results cancel out. Of the positive results, only 12 show a difference greater than 6 cm. over the controls, and investigators with experience of inoculation experiments on *Hevea brasiliensis* would

hesitate to consider less than 6 cm. a positive result. The response of individual trees, even to slight wounding, as indicated by the amount of discoloration, differs widely and it may be suggested that this individual variation might account for some of the differences. The above inoculation results are not substantial enough to influence the work of other investigators.

EXPERIMENTAL PRODUCTION OF THE DISEASE.

This heading indicates one of the most important and interesting parts of Rand's work in Java. The failure of his numerous and varied attempts to isolate a causal organism led him to attack the subject from a different angle. His experience indicated that heavy tapping i.e. overtapping, had a considerable significance when a heavy percentage of Brown Bast infection occurred. Working on this line he performed the following experiment.

Three adjacent rectangular blocks of 50 trees were taken as Groups A.—B.—C.:—

Group A :—Tapped six times a day at two-hour intervals beginning at 6 a.m. The system used was two cuts on $\frac{1}{3}$ of the circumference at a height of $1\frac{1}{2}$ metres. The results showed 40% of typical Brown Bast trees in two weeks, 50% at the end of four weeks 60% in 8 weeks.

Group B.:—Tapped once per day on the same system as Group A. at 6.30 a.m. The result showed 2% Brown Bast after 4 weeks, 4% after 6 weeks and 10% after 8 weeks.

Group C.:—Tapped six times per day as in Group A but only on $\frac{1}{4}$ cut at a height of 50 cm. The result showed only 2% of Brown Bast during the month it was tapped.

This was the first successful attempt to produce Brown Bast artificially and Dr. Rands is to be congratulated on opening a new avenue by which knowledge could be gained.

A noticeable feature in the above tapping experiments in Group A. was that the disease usually appeared about the middle of the upper cut. Hamaker has recorded a similar observation on estates tapping on two superimposed cuts. He says that 72%—83% of his affected trees become diseased on the upper cut.

The Brown Bast Investigation Committee in Malaya instituted experiments along similar lines. It was found however, that otapping 6 times a day did not work satisfactorily as no latex was obtained from the later tappings. Belgrave suggested as an alternative, one cut on a full spiral daily.

Experiments were set up to test the comparative effect of daily, alternate day and every third day tapping, on full spiral, half spiral and a $\frac{1}{4}$ cut. The results are tabulated. Yields were also kept.

System.	Month.	Brown Bast.	No. of trees tapped.
$\frac{1}{4}$ Cut Daily tapping ...	April 1919 ...	—	515
„ Alternate day tapping ...	„ „ „	—	530
„ Every third day ...	„ „ „	—	502
$\frac{1}{2}$ Spiral Daily tapping ...	„ „ „	—	341
„ Alternate day tapping ...	„ „ „	—	331
„ Every third day ...	„ „ „	—	350
Full Spiral Daily tapping ...	„ „ „	—	536
„ Alternate day tapping ...	„ „ „	—	517
„ Every third day ...	„ „ „	—	538
$\frac{1}{4}$ Cut Daily tapping ...	End of Sept., 1919 ...	3	515
„ Alternate day tapping ...	„ „ „	2	530
„ Every third day ...	„ „ „	1	502
$\frac{1}{2}$ Spiral Daily tapping ...	„ „ „	2	341
„ Alternate day tapping...	„ „ „	2	331
„ Every third day ...	„ „ „	—	350
Full Spiral Daily tapping ...	„ „ „	45	536
„ Alternate day tapping ...	„ „ „	12	517
„ Every third day ...	„ „ „	5	538
$\frac{1}{4}$ Cut Daily tapping ...	End of Dec., 1919 ...	5	510
„ Alternate day tapping ...	„ „ „	2	528
„ Every third day ...	„ „ „	2	500
$\frac{1}{2}$ Spiral Daily tapping ...	„ „ „	8	333
„ Alternate day tapping ...	„ „ „	3	328
„ Every third day ...	„ „ „	1	349
Full Spiral Daily tapping ...	„ „ „	102	434
„ Alternative day tapping ...	„ „ „	34	483
„ Every third day ...	„ „ „	24	513

The above results undoubtedly confirm those obtained by Rands, though it does not support his statement that "this experiment, nevertheless furnishes striking evidence on the relation of the *number of cuts* to the development of Brown Bast." It is evident, that a single cut of extreme length will give similar results to a number of shorter cuts. The Malayan experiments appeared to show many interesting relationships and were continued and extended to endeavour to obtain substantial experimental proof in several directions. These it is hoped will form the subject of a future publication.

RELATION OF ABOVE TO DEVELOPING IMMUNE TREES.

An important aspect of Rand's work was the endeavour to interpret his results along the lines of obtaining trees of *Hevea brasiliensis* immune to Brown Bast. He showed in his experiments that, in a general way, high yielding trees seemed to be most susceptible to attacks of Brown Bast—i.e. *developed Brown Bast more quickly than trees yielding less latex*.* At the same time were noticed high-yielding trees which did not develop Brown Bast quickly under a severe tapping system.

Rands assumed that the resistance observed on high-yielding trees might be due to specific immunity and by applying his system of tapping it might be possible to select the resistant high-yielding trees; breeding from these, a strain of *Hevea Brasiliensis* immune to Brown Bast might be developed. Experiments were started along these lines and trees marked from which selected seed was obtained and planted. A considerable number of years must elapse before the results can be published.

Experimental evidence adduced, in Malaya, over the last two years does not support the probability of successfully developing rubber trees immune to Brown Bast.

The following is a record of the behaviour of three neighbouring blocks of 50 trees each, two tapped $\frac{1}{2}$ spiral daily, the other $\frac{3}{8}$ spiral daily. The trees were of the same age and equally developed and there was no reason to suspect any essential difference in the final results. From previous experimental observations it was expected that the more severely tapped $\frac{7}{8}$ spiral block would give a higher number of Brown Bast trees, than the $\frac{1}{2}$ spiral blocks, but this was not the case. Twelve months tapping on the $\frac{7}{8}$ spiral block gave only one Brown Bast tree, so that for practically 12 months this block was immune (or rather, disease-free A.S.) according to the suggestions made by Rands. The half spiral blocks showed 9 and 21 Brown Bast trees respectively. In the latter case some allowance must be made, as a three months tapping on a full spiral was made on two large blocks which later were divided into eight small blocks of about fifty trees to determine their probable behaviour under the same conditions. This half spiral block of 50 trees had seven Brown Bast trees as a result of the preliminary three months tapping. However, it must be emphasised that three months preliminary heavy tapping over large blocks gave little indication of the large differences to be expected on the smaller blocks. It might be pointed out that Rands tapping for selective work extended over only four months actual tapping time, which in view of the above, can hardly be considered a sufficiently long period.

Returning to the three experimental blocks above mentioned total rubber yields for the experimental period were kept and were as follows:—

				lbs.
$\frac{1}{2}$ Spiral	...	(a) Brown Bast trees	21. ...	296.06
$\frac{1}{2}$ "	...	(b) " " "	9. ...	312.11
$\frac{7}{8}$ "	...	(c) " " "	1. ...	348.10

* (*Italics mine A. S.*)

The total yield gives no dependable basis of comparison for trees were continuously going out of tapping owing to Brown Bast. The average yield per tree over the period showed.

	Brown Bast trees.	lbs per tree
(a) $\frac{1}{2}$ Spiral	21.	10.22
(b) $\frac{1}{2}$ "	9.	7.45
(c) $\frac{7}{8}$ "	1.	7.58

On these results it would appear that there is little relation between yield and number of Brown Bast trees.

Between August and September 1921 however, there was a sudden increase in the number of Brown Bast trees in the $\frac{7}{8}$ spiral plot, coincident with a similar increase in other plots tapped on various systems; after 12 months without an increase in the number of Brown Bast cases seven trees went out of tapping with Brown Bast. There was a large increase in the average monthly tree yields from this plot, coincident with the sudden increase in the number of Brown Bast cases. This increased yield has been sustained for 12 months and the plot is behaving normally as compared with seven other plots.

General conditions of growth affect the percentage development of the disease to an enormous extent in all countries, according to the results published by various investigators, and seed from trees selected for their resistance to Brown Bast may be less susceptible under one set of conditions than under others. Specific immunity is difficult to realise in view of these facts. Moreover in seed selection as so far practised on rubber plantations too little attention is given to the possibilities of the male parent influencing the results. The male characteristics are of obvious importance in any breeding work, but in selection work on rubber this point appears to be missed on occasions.

Various:—The remainder of the Brown Bast work in Rand's publication, apart from his anatomical observations published in a separate article, is rather more general. He deals with relation of Brown Bast and some environmental factors and his general observations indicate that the most vigorous trees judged by appearance, size and cambial activity, are most liable to develop Brown Bast. These trees are often the highest yielding trees. In discussing influence of soil conditions he makes a general statement that trees on poor soil or on exposed flat ridges have a smaller amount of disease than adjacent, rich, well-drained flats. He states further that elevation through its influence on growth and yield also affects the amount of disease.

The general conclusion as stated by Rands is "Previous results are in accord with the conclusion that vigorous high-yielding trees are more liable to Brown Bast than thrifty, uncrowded ones." This has been substantiated by the Brown Bast Investigation Committee by observations made on rubber estates opened up on old tapioca soil, where the trees are of poor growth with tough cortex. Even if Brown Bast is present, its progress is slow and the area restricted in extent

After the most susceptible trees have been removed from a stand, it is probably inadvisable to thin out further on a disease basis alone. This is because a high-yielding, not too susceptible tree will probably produce more in the long run than a low-yielding, more resistant type tapped continuously. The thinning-out problem will be easier if we follow the advice of Hamaker and others who advocate making the new plantings dense in order to be able later to thin out on a basis of yield and disease. The most susceptible and otherwise undesirable individuals are thus eliminated without disturbing greatly the space arrangement of the remainder of the trees."

The thinning-out advice given above may be sound for Java and Sumatra, but the writer disagrees with the above suggestions if applied to Malayan plantations.

PREVENTION OF BROWN BAST.

Rands considers the question of Brown Bast prevention and his observation led him to state "A high percentage of Brown Bast was usually directly traceable to the use of a tapping system with one cut above the other tapped daily" and says further "From the standpoint of Brown Bast there seems sufficient reason to condemn the use of superimposed cuts." As far as the minutes of the Brown Bast Investigation Committee go there is no substantiating evidences for Malaya; there is no doubt that Malayan estates using other systems have had a high percentage of Brown Bast. Our experimental observations however indicate that it is not a question of any special systems of tapping, but that under any given combination of conditions a certain definite limit is set with regard to quantity of latex extracted, below which only a small percentage number of Brown Bast cases is to be anticipated. Once this limit is passed, the increase in the percentage number of Brown Bast cases is very sudden and out of all proportion to the extra amount of latex extracted.*

Rands discusses the question of Daily and Alternate Day tapping with reference to Brown Bast prevention. His general observations show a decided inclination in favour of Alternate Day tapping, which is in accordance with Malayan observations. Rands states that no thoroughly controlled tapping experiments comparing alternate with daily systems have as yet been carried out for a sufficient length of time to decide the relative merits as regards yield but a series is now being carried out on the estates in Java in co-operation with the West Java Experiment Station. The figures given in our tables indicate the large difference between Daily and Alternate Day tapping as regards Brown Bast development when a heavy tapping system is used. These figures are not meant to show any crucial difference upon which we can base advice with reference to the tapping system to be adopted, for further experiments suggest significance in directions other than the obvious, and extended observations are necessary before drawing probable conclusions.

* This is supported by further analysis. Substantial evidence is now in hand to show that when drastic tapping is in operation, the relationship shown by yield figures obtained by estate routine tapping systems no longer holds between comparisons of Daily Tapping, Alternate Day Tapping and Every Third Day tapping on similar lengths of cut.

TREATMENT OF BROWN BAST.

Brown Bast treatment is not dealt with in detail by Rands. He calls attention to the different methods advocated by different experts. These are the well known (1) Stripping (2) Deep scraping (3) Light-scraping, with hot tar method. In a review of this description it is unnecessary to go into details regarding methods well established but two points of interest might be noted for the benefit of Malayan Planters. Stripping is suggested in Malaya as offering the best results and is strongly recommended by Sanderson and Sutcliffe; a note of warning has already been sounded by the Brown Bast Investigation Committee with regard to where Mouldy Rot is prevalent in areas where Brown Bast is being treated by stripping. The greatest care is necessary in these areas, for the Mouldy Rot fungus attacks carelessly protected stripped surfaces very rapidly.

HISTOLOGICAL AND HISTORICAL.

It may be of interest to consider the history of Brown Bast disease before dealing with the investigations relating to the morbid anatomy of the tissues attacked. The realisation of Brown Bast disease forms a notable illustration of the confusion which arises as a result of empirical generalisations based on insufficient experimental work.

Petch in 1910 was the first to suggest *Phytophthora faberi* (Maub.) as the fungus causing a Canker of the bark of *Hevea brasiliensis* (1). This was confirmed by Rutgers (2) in Java whose extended observations practically included all known Bark affections at the time; very different symptoms were considered as different manifestations of the attacks of a single fungus i.e. *Phytophthora faberi* (Maub.). It has been pointed out elsewhere (3) by the writer and others that Rutgers's claims to have established his conclusions cannot be accepted.

However, in 1913, Rutgers paid a visit to the Federated Malay States and pointed out "Barred trees" as illustrating the fact that *Phytophthora faberi* was active in the country, a statement which the writer and other mycologists working in the Federated Malay States strenuously denied, for innumerable attempts at isolation had been made without success. He reiterated his conviction (4) during a discussion on a joint paper contributed to the Batavia Conference in 1914 by Brooks and the writer. In view of his dogmatic attitude it might be expected that conclusive proofs would be forthcoming but it would appear that field observations formed the basis for his conclusions.

(1). Petch. T: Cacao and Hevea Canker. Cires, and Agricultural Journal of the Royal Botanic Gardens, Ceylon Volume 5 No. 13 November, 1910.

(2). Rutgers A.A.L. and Dammormann K.W.: Diseases of *Hevea brasiliensis* in Java: Med Van het Laboratorium Von Pflanzenziekten No. 10. p. 27-33, 1914.

(3). Sharples. A. Belgrave W.N.C. Norris F. de la Mare and Ellis A.G.G. Black Stripe and Mouldy Rot of *Hevea brasiliensis* Bull. No. 31 Department of Agriculture, Federated Malay States, 1920.

(4). Report of the International Rubber Congress and Exhibition. Batavia. 19th to 23rd October, 1914

Time again has shown in this case, how vital is the necessity for reservation of opinion in the matter of plant disease problems when no absolute evidence has been adduced upon which definite conclusions can be based. With regard to the "A," "B," "C," and "D," forms of Bark Canker recognised by Rutgers in 1914 as all caused by *Phytophthora faberi* the position in Malaya to-day is:—

"A" form produced by a *Phytophthora* sp. related to the *Phytophthora* sp. from Burma (*P. Meadii*).

"B" form i.e. (Claret Coloured Bark Canker) produced by a *Phytophthora* sp.* different from the species causing Black Stripe in Malaya. According to Petch the fungus causing Claret Coloured Bark Canker in Ceylon is *Phytophthora faberi*. (Maub).

"C" form : probably comprised in Brown Bast.

"D" (Burrs) form :—following on a Brown Bast attack.

Thus there are at least three different diseases produced by different causes, and the confusion surrounding the cause of the varied symptoms described by Rutgers could not have arisen had sufficient attention been given to fundamental principles. Petch (1) points out that a suggestion by Rands (loc cit) that the confusion between the various bark diseases arose in Ceylon could not be substantiated by facts, a statement obviously to the point when the literature is studied.

The formation of Burrs, now recognised as a feature of Brown Bast, has claimed much attention from an anatomical standpoint during the last 8—10 years. Up to 1917 when the intensive study of Brown Bast was commenced, most investigators had accepted Bateson's (2) and later Bryce's (3), work which confirmed Bateson's. Those authors, made careful studies of Burred tissues, without associating those growths with any specific disease, and considered that the primary stimulus which resulted in the initiation of Burrs usually arose as a result of the latex coagulating after escape from broken latex vessels. Bateson made one important statement which recent study has confirmed, that "exhaustive tapping favours the development of "Burrs." The writer cannot agree that this statement made as a result of field observations on ten trees standing in the Government Experimental Plantation, Kuala Lumpur, entitles Bateson to the claim

* Vide minutes of Brown Bast Investigation Committee and Successful isolations and inoculations by Mr. R. M. Rands.

(1). Petch, T:—Archief Voor Rubber Culture, Aug. 1921.

(2) Bateson, F:—Burr Formation:—A preliminary Note: Agricultural Bulletin Federated Malay States: July 1913.

(3). Bryce C:—Bulletin No. 28. Department of Agriculture Ceylon, October 1916.

(4). Sanberson R. A and Sutcliffe H:—"Brown Bast, an investigation into its Causes and Method of Treatment" Rubber Growers Association 38 Eastcheap, London, E.C 3.

made by Sanderson and Sutcliffe that he was the first investigator of Brown Bast to suggest a physiological origin of the disease. Bateson saw the results of exhaustive tapping in 1914 but Brown Bast as such, was not conceived till towards 1917.

Bryce (loc cit) dealt fully with the abnormal anatomical developments known as Burrs. Sanderson and Sutcliffe (4) have lately followed similar lines to Bateson (loc cit) and Bryce (loc cit) and their work was summed up by Farmer and Horne (loc cit) as follow:— "They had shown that "Burrs" result from the inclusion of areas of diseased laticiferous tissue in stone cell pockets formed by the activities of wound cambiums." Bryce in a letter to Nature (15th Sept. 1921) points out that the features observed by Sanderson and Sutcliffe have long been known but that the above statement is at variance with the results obtained by workers in the East generally. From the writer's point of view the anatomical investigations dealing with Burred tissue which are after effects easily observed, will not lead us far in elucidating the cause of Brown Bast, and it is difficult to see how Sanderson and Sutcliffe could claim to put forward a new physiological theory when their work was based on Burred tissue examinations.

Much attention has been directed to Farmer and Horne's (loc cit) work in England on preserved specimens sent from the Middle East. In early stages of the disease they showed abnormal changes occurring in the sieve-tubes the important conducting elements in the bark. Any interference with the conducting system is obviously serious, and it may be that this is the first direct effect when Brown Bast sets in.

A recent view has been expressed by experienced authorities (1) that the sieve-tubes in some cases, are not the all-important channels for conducting food materials from the leaves. Ringing experiments were carried out by the officers of this Department in 1917, on *Hevea Brasiliensis*, and the trees, ringed deeply to the wood, are still healthy, though there has been no bridging of the ring by callus ingrowths. So it is possible that the sieve-tubes in *Hevea* may be comparatively unimportant as regards conduction.

Further anatomical investigations continued over three years show many peculiarities in sieve-tube changes, even in healthy trees. Lignification or necrosis of sieve-tubes has been observed in perfectly healthy plants: the last few months have been spent examining bark from trees which have not been tapped for 5 years, none of these trees having suffered previously from Brown Bast. Our results up to date show that a large percentage of these trees have lignified sieve-tubes. It would appear from our work that too much importance has been assigned to Farmer and Horne's observations, which we hope to deal with in detail in a future publication.

(1), Dixon H H. & Ball. N G. Transport of Organic substances in plants
Letter to Nature No. 2730 Vol. 109 February 23rd 1922.

SUMMARY.

Many other papers have appeared, dealing primarily with the histology of Brown Bast tissues i.e. the microscopic reaction of the tissues attacked by Brown Bast to various reagents. These are of little importance to the planter and need not be considered further in this article. The important points to be noted in relation to the future policy on rubber plantations are:--

(1) The balance of evidence is overwhelmingly in favour of Brown Bast being a non-transmissible disease of physiological origin.

(2) That heavy tapping on well grown plantations raises the percentage development of Brown Bast enormously.

(3) That under a heavy tapping system, i.e. usually much heavier than is adopted in estate practice, as in the Full Spiral, Alternate day tapping shows a much lower percentage development of Brown Bast than daily tapping on the same system.

These broad facts must be considered in relation to future policy in Malaya. This would make the present article much too long if taken in detail, but a brief statement can be made now.

Much interest has been aroused during the last two years by statements and predictions regarding possible yields on rubber plantations in years to come as a result of selection, bud-grafting etc. Two thousand lbs. per acre has been suggested as a possibility from 40 trees per acre. The statement that "Good yielders always remain good yielders" has been much emphasised and that good yielders can be selected by counting the number of latex rings. A recent paper (1) shows that no significant correlation exists between yield and number of latex rings, so that this method of ensuring the selection of the best yielders for which much has been claimed, can be considered of doubtful utility. Selection by a careful estimate of yields, which is a long and tedious process, is the only sure basis of differentiating between good and bad yielders over the period during which the estimates are taken. In general it may be true that "Good yielders remain good yielders" but all investigators working on *Hevea brasiliensis* know that there are exceptions and when individual trees are considered, good yielders may become normal yielders or even poor yielders and vice versa. The writer has had several cases under observation and is of the opinion that the exceptions are probably more numerous than the supporters of the "Good yielders" idea may admit: further they might be of great significance and require careful consideration before a dogmatic statement is made.

In the recent paper by La Rue above mentioned (loc cit) he says that Dr Rands has unpublished data, showing "that type of bark structure may change with changed conditions, so that the same tree

(1) Rue, C.d.La:--Structure and yield in *Hevea brasiliensis* Archief Von Rubber Culture: 5c Jaargang No. 12 Dec 1921.

may change from one type to another," and there is little doubt that such changes will result in large variations in amount of latex obtained.

The following question is for the future. Will the cumulative growth conditions, i.e. type of soil, atmospheric humidity etc. etc. function, in co-operation with Brown Bast, as a limiting factor, setting a fairly definite limit to the amount of latex to be obtained from any rubber producing area? In the absence of high yielding trees resistant or immune to Brown Bast, this question is of the utmost practical importance and until evidence for or against has been gathered, an open mind is advisable. Loose statements as to greatly increased yield in the future are to be strongly deprecated; they may be interesting from a speculative point of view but progress will only be made by an arduous collection of facts and figures from which true deductions can be made.

ADDENDUM.

The review was written up several months ago. In the interim an interesting article by Keuchenius has come to notice, giving details of his Sumatran experiments. This paper will be fully considered in the light of experimental work carried on in Malaya during the last three years, as soon as our experiments can be conveniently written up. The writer is preparing a preliminary report for early publication indicating the issue of the above mentioned experiments.

Department of Agriculture, F.M.S. & S.S.

PRICE LIST.

Economic and Non-economic Planting Material.

FRUIT SEEDLINGS.

Avocado Pear (<i>Persea gratissima</i>).	
Blimbing (<i>Averrhoa Bilimbi</i>).	
Bullock's heart (<i>Anona reticulata</i>).	
Carambola (<i>Averrhoa Carambola</i>).	
Chiku (<i>Achras Sapota</i>).	
Durian (<i>Durio zibethinus</i>).	
Guava (<i>Psidium Guajava</i>).	
Jack fruit (<i>Artocarpus integrifolia</i>).	
Jambu bol (<i>Eugenia malaccensis</i>). Red Malay apple.	
Lemon (<i>Citrus Limonum</i>).	
Lime (<i>Citrus acida</i>).	
Manggis hutan (<i>Garcinia Hombroniana</i>).	
Mangosteen (<i>Garcinia Mangostana</i>).	
Monkey Jack (<i>Artocarpus rigida</i>).	
Orange (<i>Citrus Aurantium</i>).	
Pomelo (<i>Citrus decumana</i>).	
Rambai (<i>Baccaurea Motleyana</i>).	
Rambutan (<i>Nephelium lappaceum</i>).	
Soursop (<i>Anona muricata</i>).	
Sugar-apple, Custard-apple (<i>Anona squamosa</i>).	
Water Lemon (<i>Passiflora laurifolia</i>).	
Numbers up to 100 seedlings	... 20 cents each.
Numbers up to 500 and more than 100	... 15 cents each.
Larger orders	... 10 cents each.
Grafted plants, when available, will be quoted separately.	

COVER CROPS.

Cassia mimosoides	seed	\$1 per lb.
Canavalia ensiformis	"	30 cents per lb.
Centrosema Plumieri (Butterfly Pea)	"	14 " " "
Clitoria cajanifolia	"	50 " " "
Crotalaria striata	"	50 " " "
Dolichos Hosei (Sarawak Bean)	cuttings	\$1 per sack.
Leucaena glauca	seed	50 cents per lb.
Mimosa invisa (Giant mimosa)	"	50 " " "
Mucuna sp.	"	50 " " "
Phaseolus lunatus (Lima Bean)	"	50 " " "
Tephrosia candida	"	50 " " "
Tephrosia Hookeriana	"	50 " " "
Tephrosia purpurea	"	50 " " "

GRASSES.

Australian Blue Couch (<i>Digitaria didactyla</i>)	\$1 per bag of plants.
Bermuda (<i>Cynodon Dactylon</i>)	\$1 per bag of plants.
Citronella (<i>Andropogan Nardus</i>)	\$2 per 1,000 plants.
Guinea grass (<i>Panicum maximum</i>)	\$2 " 1,000 "
Lemon (<i>Andropogan citratus</i>)	\$2 " 1,000 "

GRASSES—*contd.*

Love grass (<i>Andropogon aciculatus</i>)	\$1 per bag of plants,
Natal Red Top grass	\$1 " " " "
Paspalum dilatatum	\$1 " " " "

Seed, when available, 10 cents per oz.

EUROPEAN VEGETABLE SEEDS.

Large seeded varieties <i>e.g.</i> , beans	15 cents per oz.
Others	30 " " "
Small Packets	10 " each.

FIBRES.

Bimlipatam Jute (<i>Hibiscus Cannabinus</i>)	seed \$1 per lb.
Kapok (<i>Eriodendron anfractuosum</i>)	seed 20 cents per lb.
Manila hemp (<i>Musa textilis</i>)	suckers 10 cents each.
Mauritius hemp (<i>Furcraea gigantea</i>)	bulbils \$1 per 100
Mauritius hemp (<i>Furcraea gigantea</i>)	young plants \$3 per 100
Roselle (<i>Hibiscus Sabdariffa</i> var. <i>altissima</i>)	seed \$3 per lb.
Sisal hemp (<i>Agave rigida</i> var. <i>sisalana</i>)	bulbils \$1 per 100
Sisal hemp (<i>Agave rigida</i> var. <i>sisalana</i>)	young plants \$3 per 100

MISCELLANEOUS ECONOMIC PLANTS.

Arrowroot	tubers 20 cents per lb.
African Oil Palm (<i>Elaeis guineensis</i>)	seed \$10 per 1,000
African Oil Palm (<i>Elaeis guineensis</i>)	seedlings \$20 per 100
Bixa Orellana	seed \$1 per lb.
Coffee (Robusta and Liberian)	seed 50 cents per lb.
Coffee (Robusta and Liberian)	plants \$2 per 100
Ipecacuanha (<i>Psychotria Ipecacuanha</i>)	cuttings 10 cents each,
Jerusalem artichoke (<i>Helianthus tuberosus</i>)	tubers 20 cents per lb.
Patchouli (<i>Pogostemon Patchouli</i>)	cuttings \$3 per 1,030
Sweet potato (<i>Ipomoea Batatas</i>)	cuttings \$1 per 100
Tuba Root (<i>Derris elliptica</i>)	cuttings \$2 per 100

NON-ECONOMIC PLANTS.

Flowering trees	seedlings from 10 to 50 cts each.
Flowering trees	seed 10 cents a packet.
Shade trees	seedlings from 10 to 50 cts. each.
Shade trees	seed 10 cents a packet.
Shrubs	rooted cuttings 10 cts. each.
Shrubs	unrooted cuttings 5 cts. each.
Climbers	rooted cuttings 10 cts. each.
Climbers	seed 10 cts. a packet.
Showy annuals	seed 10 cents a packet.
Palms	seedlings from 20 to 50 cents each.
Palms	seed prices on application.
Ferns	cuttings 10 to 25 cts. each.
Bulbs	10 cents each.
Standards	20 to 50 cents each.

The above prices are quoted for material when available. Planting material of other agricultural or horticultural plants will be quoted, on application, when available.

District.	Mean Barometrical Pressure at 32° Fah.	Maximum in Sun.	TEMPERATURE.				HYGROMETER.				Prevailing Direction of Winds.	Total Rainfall.	Greatest Rainfall during 24 hours.
			Mean Dry Bulb.	Maximum.	Minimum.	Range.	Mean Wet Bulb.	Vapour Tension.	Dew Point.	Humidity.			
Kelantan, Kota Bharu	...	142.21	83.1	91.00	74.6	16.23	77.8	.836	74.2	74%	...	13.47	2.71
Pahang, Kuala Lipis	...	...	81.2	90.6	71.5	19.1	76.4	...	...	...	...	4.89	1.38
Johore, Johore Bahru	...	...	...	87.55	73.33	...	...	...	...	...	...	6.01	1.74
Singapore, Kandang Kerbau	...	...	81.8	84.4	78.4	...	77.6	.915	...	84.	Cal.	4.99	3.46
Malacca, Durian Daun	...	126.	83.	88.	74.	14.	78.	.915	...	82.	N.W.	7.99	1.92
Negri Sembilan, Seremban	...	156.	79.9	87.9	75.9	12.	76.1	.818	73.4	81.	N.E.	4.48	1.69
" Kuala Pilah	...	149.7	82.	89.9	71.8	18.1	78.5	.905	76.3	83.1	...	3.18	1.69
" Port Dickson	...	150.7	83.	88.6	74.9	13.7	78.3	.881	75.5	78.	...	4.11	1.10
Selangor, Kuala Lumpur	...	151.1	82.4	89.7	73.6	16.1	77.4	.846	74.2	76.	S.E.	5.31	2.51
" Klang	...	...	82.1	86.9	75.1	11.8	77.6	...	...	...	...	3.53	1.78
" Kuala Selangor	...	...	...	90.3	70.1	20.2	...	...	...	...	...	2.41	1.60
" Rawang	...	...	...	...	...	...	...	...	...	...	...	...	...
Perak, Telok Anson	...	...	82.83	92.	70.	22.	76.18	.813	...	73.	...	1.25	.48
" Ipoh	...	...	83.03	96.	71.	25.	67.30	.862	78.11	77.	...	6.96	3.18
" Taiping	...	...	82.62	94.	70.	24.	77.46	.900	...	87.	...	5.94	2.63
" The Cottage	...	...	...	...	...	...	...	...	...	...	...	19.52	4.84
" Parit Buntar	...	...	83.51	92.	73.	19.	78.78	.918	...	81.	...	2.87	.74
Penang, George Town	...	152.	83.9	92.	68.	24.	79.2	.928	72.4	80.5	N.W.	9.25	4.07
Kedah, Alor Star	...	...	...	...	...	...	...	...	...	...	...	7.03	1.74
Perlis, Kangar	...	...	...	89.46	74.13	15.33	...	...	...	...	...	4.37	1.22